MODIS/Snow Project
Quarterly Report
July-September, 1992
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Near-term objectives and anticipated activities during the next quarter:

During the next 6 months, we will work in several different areas: snow mapping algorithm development, analysis of 1992 ASAS data, and collection and analysis of MODIS Airborne Simulator (MAS) data in California and Saskatchewan.

We will continue to refine the snow-mapping algorithm that has been developed using thematic mapper (TM) data. We will modify the algorithm by using TM band 4 instead of band 2 and assess the results. We will also test the algorithm on a variety of scenes, beginning with a 14 March 1991 TM scene acquired of Glacier National Park, Montana. This scene contains a variety of types of snow cover, both pure snow (over large lakes) and snow in forested areas.

ASAS data, collected in February 1992 over Glacier National Park, MT, are currently being processed by Jim Irons's ASAS group and we are receiving a large amount of data. In the near future, we will analyze the ASAS and simultaneously-acquired SE-590 data. We will use the 6S atmospheric correction code to calculate the ground reflectance. We will analyze, quantitatively, the difference between measuring the reflectance at nadir versus measuring the hemispheric reflectance using both ASAS and SE-590 data. We also will determine how closely the ASAS and SE-590 data correlate for analysis of the reflectance of snow over lakes and in forested areas of Glacier National Park.

During the month of December, we will acquire more MAS data from the NASA ER-2. We have arranged a flight over the Sierra Nevada Mountains during a test flight of the MAS in mid-December. In addition, during the week of December 14, the ER-2 will fly to Saskatchewan for a snow mission for which Al Chang/974 is the P.I. In addition to obtaining passive microwave data, MAS data will be acquired for the MODIS/snow project. Al Chang, Jim Foster and Dorothy Hall will be in the field along with collaborators from Canada, to obtain field measurements of snow simultaneous with the aircraft overflight. The additional MAS data to be acquired next December should help us to refine our snow mapping algorithm and to understand the utility and limitations of some of the channels that will be flown on MODIS for snow mapping.

Task progress:

Progress has been made in each of the areas mentioned above.

Over the last 3 months the snow cover mapping algorithm has been refined and currently has been shown to be effective for mapping snow-covered areas on several TM scenes (Riggs et al., 1992: Proceedings of the American Society of Photogrammetry and Remote Sensing Convention). The algorithm has been effective in mapping sunlit snow, and snow in mountain shadows. Analysis has focused principally on the use of TM bands 2 and 5, located in the visible and near infrared parts of the spectrum. These bands were selected because their spectral coverage corresponds to MODIS bands 4 and 6. A normalized snow difference index (NSDI) has been developed, where NSDI=(reflected visible - absorbed near infrared) / (reflected visible + absorbed near infrared), or

$$NSDI = (TM2 - TM5) / (TM\ 2 + TM5). \qquad (1)$$

While the algorithm has been useful for separating many types of clouds and snow, problems have occurred in the separation of snow and water.

ASAS data acquired on 26 February 1992 of the western part of Glacier National Park have been received and analysis has begun and is in the very early stages. Data from both forested and meadow sites have been received and it has been determined that the quality is quite good in general. Preliminary results show that the data (from the snow-covered meadow sites) acquired both at perpendicular and oblique angles relative to the principal plane of the Sun are very similar, and only the data acquired parallel to the principal plane of the Sun, and facing the Sun show the increase in reflectance with increase in view-zenith angle that is characteristic of snow. Some of the data acquired at higher view-zenith angles are blurred due to jitter of the sensor, but the data are still usable.

The MAS data that were received early this year proved to be useful for mapping snow in the Sierra Nevada Mountains (Hall et al., in press: Proceedings of the 49th Annual Eastern Snow Conference). However, it became obvious that in order to map the snow in the mountains and interpret the results correctly, some topographic information must be obtained. This is especially important for understanding the thermal infrared data of snow because the surface temperature of the snow is a function of elevation and also slope and aspect. Thus the USGS digital elevation model (DEM) data were ordered, and when received, will be registered to the 1991 (and perhaps 1992) MAS data.

Problems/corrective actions N/A

Publications/Presentations:

During the last quarter, the following presentations were given:

Riggs, G.A. "Evolution of the snow cover algorithm for the Moderate Resolution Imaging Spectroradiometer," American Society of Photogrammetry and Remote Sensing Convention, 7 August 1992, Washington, D.C.

Salomonson, V.V. "Snow properties algorithm development for the EOS Moderate Resolution Imaging Spectroradiometer," COSPAR Meeting, 3 September, 1992, Washington, D.C.